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(54) Rotational drives converting linear fluid flow into rotational movement

(57) Four equally spaced radial arms (12, 14, 16 and 18) support a rigid mesh (20, 22, 24 and 26), attached to each of which are a plurality of hinged or flexible flaps (28) e.g. polyethylene. The mesh is porous to the flow of air or water and consequently the area presented to the flow on one side of the vertical axis of rotation is different from that on the other due to the deflection of the flaps (28) away from the rigid mesh on the one side and the layering function of the flaps on the other side.

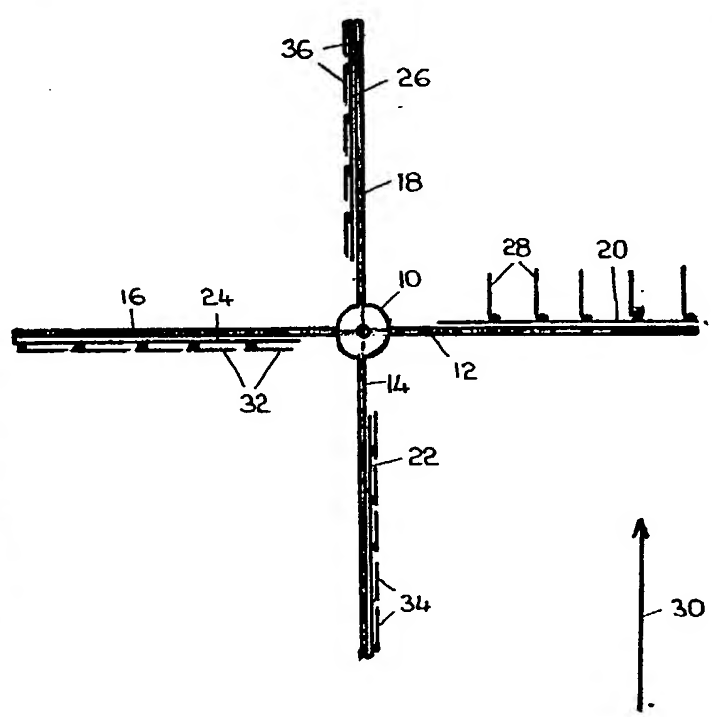

Fig. 1

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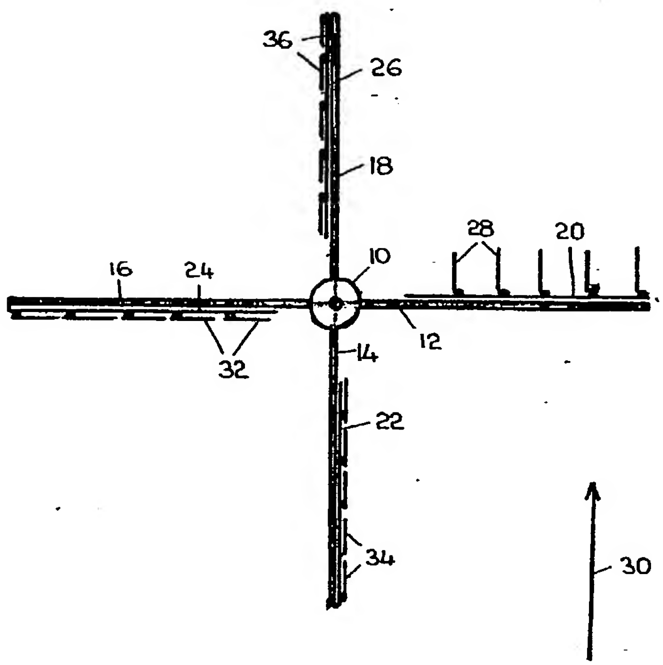

Fig. 1

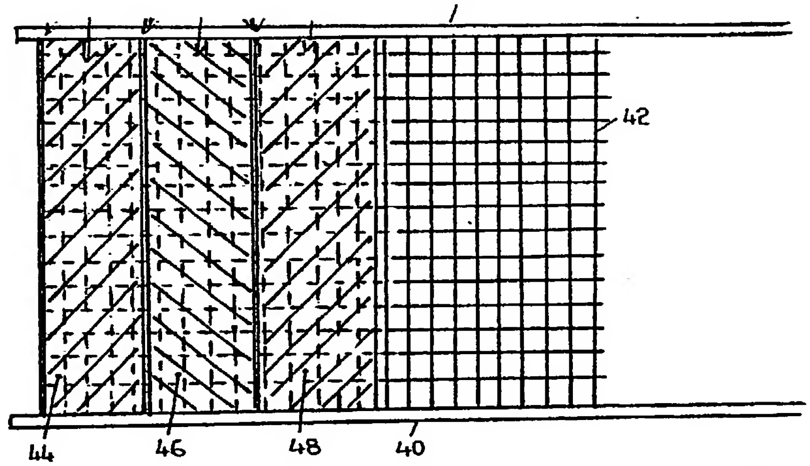

Fig. 2

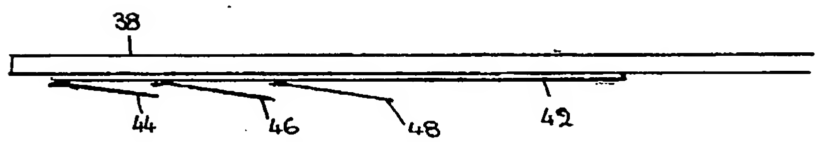

Fig. 3

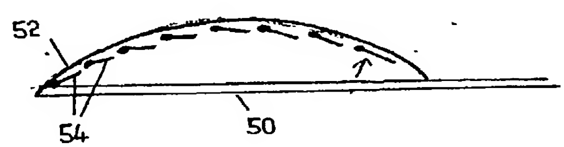

Fig. 4

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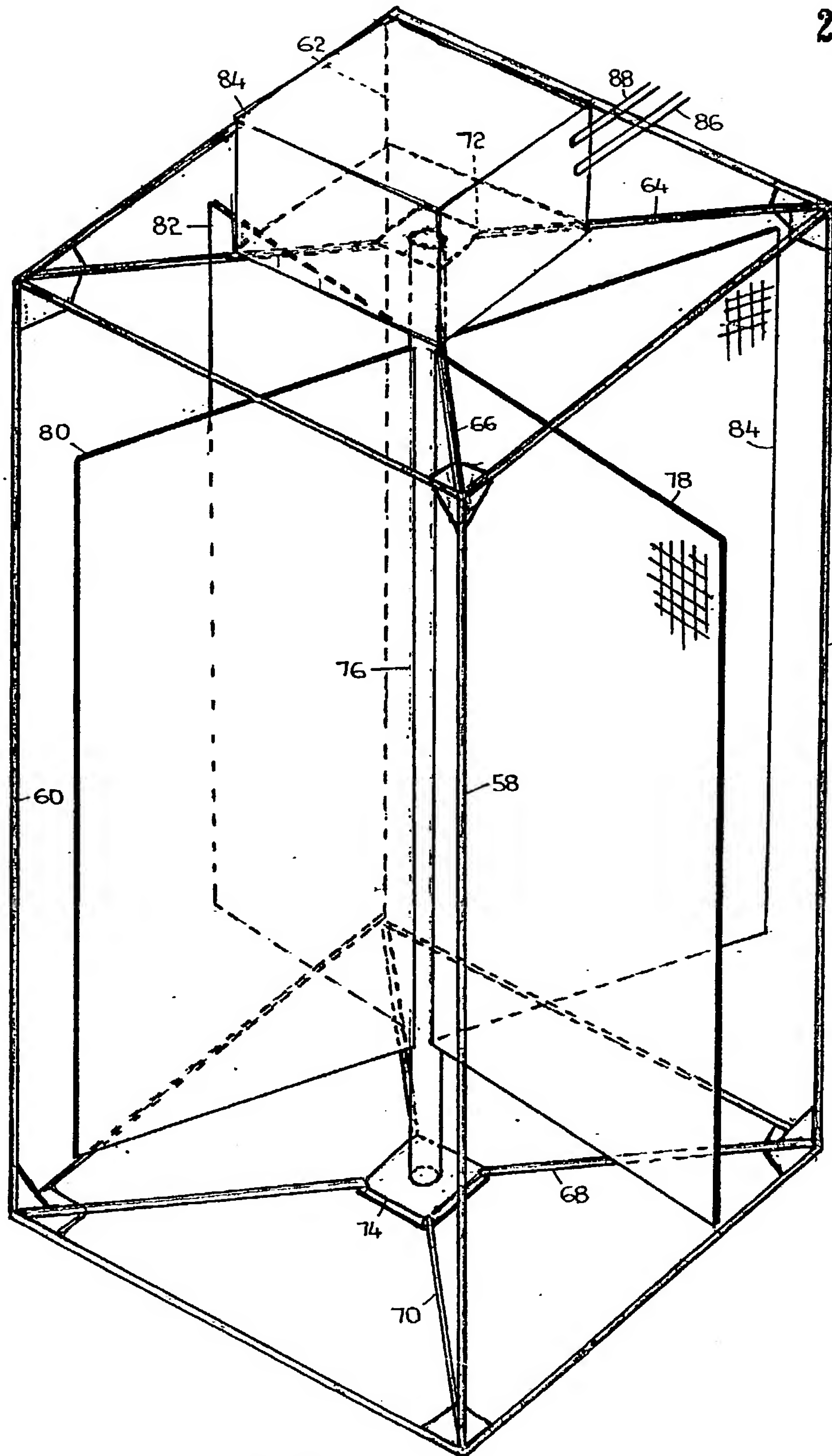

Fig. 5

SPECIFICATION

Rotational drives

Field of invention

This invention concerns rotational drives such as windmills and watermills and the like.

Background to the invention

Conventional watermills and windmills rotate about a horizontal axis with the vanes of the windmill or the water wheel in a watermill located so as to interrupt a fluid flow of air or water which is moving either tangentially relative to the wheel or axially relative to the sails or vanes of the windmill, the interaction between the fluid flow and the windmill or watermill causing the momentum of the fluid to be converted into rotation of the windmill or the water wheel.

It is an object of the present invention to provide an alternative and improved form of rotational drive which will convert linear fluid flow (air or a liquid such as water) into rotational movement.

The invention

According to the present invention a rotational drive for converting linear fluid flow of air or liquid into a rotational movement comprises a rotational member mounted for rotation about a vertical axis having at least two radial arms from which movable members depend so as to define a movable baffle which can be acted on by a stream of fluid such as air or water to produce rotational movement, a second fixed member mounted on one side of the movable members depending from each radial arm which allows fluid flow to pass therethrough when interposed between the fluid flow and the movable members but serving as a stop against which the movable members are forced by the action of the fluid flow when the said movable members are situated in front of the fixed member in relation to the direction of fluid flow so that when the direction of fluid flow transversed to the upright vertical axis a greater thrust is transmitted to the radial arm on one side of the axis than the thrust exerted on a diametrically oppositely extending radial arm by the fluid flow acting on the other movable members.

The differential thrust is obtained as a result of the freedom to move on the part of the movable members depending from one of the radial arms and the prevented movement of the movable members depending from the other diametrically opposite radial arm. This is brought about by the presence of the fixed apertured member adjacent each of the arrays of movable members.

In a preferred embodiment four or more such radial arms are provided and the assembly can be likened to an assembly of vanes or paddles which are constructed on the one hand from wire reinforced nets held between radially extending arms mounted vertically above the other from a central rotatable axle with flexible unperforated material in strips attached to the mesh along the edges of the strips towards the outside of the vanes in such a way that the unattached edge will abut and overlie the attached edge of the next strip when the strips are located on the windward side of the reinforced net but are flexed away from the adjoining attached edges when the net member is on the windward side of the strips.

It will be seen that when fluid flow is exerted onto the side of the vane to which the strips are attached, the material is forced against the mesh and forms a fluid-tight barrier. The mesh or net prevents it from flexing away and a solid surface is thus presented on which the fluid flow can exert a considerable thrust depending on the relative force of the fluid flow and the total area. With the fluid flow direction the same but after the vane has rotated around the vertical axis through 180°, the net or mesh is now on the windward side and being perforated allows the wind to pass through and flex back the material of the strips thus presenting a greatly reduced surface area to the wind and consequently a lesser thrust than exists on the opposite side of the axis. The member mounted on the vertical axis is thus caused to rotate by the force of the fluid flow acting on the greater surface area as compared with the other smaller surface area.

Since the device is designed to rotate about a vertical axis, the direction of fluid flow is unimportant assuming that there is no vertical flow since the vanes will react in the same way to any movement of air and therefore no mechanism is needed to rotate the rotatable member so as to face the wind as it is necessary with a windmill or waterwheel operated in a conventional manner about a horizontal axis.

A further advantage is that since the axis is vertical, a shaft attached to the rotating member is also automatically vertical and this eliminates the need for bevelled gearing to convert a horizontally rotating drive into a vertical drive shaft to communicate between for example the top of a windmill and the bottom as is normally the case.

In the case of a water operated device, the vanes or paddles will typically be located below the level of the river so that the flow of the river induces rotation of the mill. Again a vertical lift as between the rotation of the mill level and rotation at the level of the river bank will be required and once again since the axis about which the mill rotates is itself vertical, no additional gearing is needed to convert rotation about a horizontal axis into rotation about a vertical axis.

To improve efficiency, the material from which the movable member or members is formed is preferably weather-proofed and water-proofed and of course hard-wearing and sufficiently springy so as to tend to return after flexure to the same plane as the net or mesh to which it is attached. It has been found that sheet plastics material particularly polyethylene is a preferred material for the movable member when formed in strips.

Instead of the vane surface being flat the principle of a mesh and movable members such as strips may be applied to surfaces curved in any direction in order to reduce the power loss caused by wind spillage where the fluid medium is wind.

In addition the roller reefing principle may be applied to each of the radially extending vanes if the mesh and strips are made to slide thereby allowing the mesh and strips to roll up on a roller mounted at a convenient position between the top and bottom of the vane. Typically this is defined by radial arms or rods. By arranging that the roller is turned by a mechanism which is activated by the speed of rotation of the overall assembly about the main vertical axis, a constant speed of rotation can be achieved from varying wind speeds by causing the mechanism to increase or decrease the surface area exposed to the wind.

Where the drive is to be rotated by wind power the vertically rotatable assembly of vanes is typically mounted within a generally open framework at the top or bottom of which is conveniently mounted a generator or pump or other device which is to be driven by the rotating assembly.

Where the arrangement is to be motivated by water power such as the current of a flowing river the assembly of vanes is again preferably mounted within a generally open framework constructed from material and in such a manner as to be adapted readily to being inserted into a fast flowing river or stream without undue corrosion occurring.

The invention will now be described by way of example with reference to the accompanying drawings.

In the drawings

Figure 1 is a plan view from above of a vane assembly embodying the invention and adapted to be rotated by wind power,

Figure 2 is a side elevation of one part of a vane of a rotating assembly such as is shown in Fig. 1,

Figure 3 is a top plan view of part of the vane assembly shown in Fig. 2,

Figure 4 is a top plan view of part of a vane in which the perforated mesh is curved, and

Figure 5 is a rotating vane assembly constructed in accordance with the present invention.

Detailed description of drawings

Fig. 1 illustrates the principle of operation of a device incorporating the invention. Primarily there is a vertical rotatable axle 10 having four equally spaced apart radial arms 12, 14, 16 and 18. The arms support a rigid mesh designated 20, 22, 24 and 26 and attached to each of the meshes are a plurality of hinged or flexible flaps two of which are designated by reference numeral 28 on the radial arm 12.

With the wind in the direction indicated by the arrows 30 the flaps attached to the mesh 20 on the arm 12 experience the full force of the wind passing through the mesh and are blown into the in-line position shown in the drawing.

The same force is exerted on the flaps two of which are designated by reference numeral 32 attached to the mesh 24 on the diametrically opposite arm 16 but because the mesh is behind the flaps on this side the flaps 32 are prevented from moving in a rearward direction and remain so as to present a solid windproof barrier against which the wind blows.

In the position shown the wind force acting on the flaps on the arms 14 and 18 is negligible and the result is that a net force acts on the assembly in a direction to rotate the assembly in a clockwise direction as shown in Fig. 1 about the axis of rotation of the axle 10.

The net force arises from the fact that the area of the flaps or strips such as 32 on the left-hand extending vane or arm is greater than the area exposed to the wind force on the right-hand extending arm or vane 12.

The turning torque so produced will produce rotation and by virtue of the mesh 22, the flaps or strips such as 34 on the arm 14 will maintain their position against the mesh as the arm 14 is rotated through the 180° to the left of the position shown in Fig. 1 and as soon as the corresponding diametrically opposite arm or vane 18 moves to the right of the position shown in Fig. 1 the vanes such as 36 mounted thereon will be forced open as a result of the wind passing through the opened strips or flaps 28 on the arm 20 and the result will be a net force continuing to act on the left-hand side of the assembly in a direction to rotate the assembly in a clockwise direction.

The positions of the strips or flaps such as 28 etc. remain thus until the arm 12 has rotated through 90° whereupon the wind force (unless it has changed direction from that shown by arrows 30) will cause the strips or flaps 28 to be aligned with the mesh 20 and continued clockwise rotation will ensure that these strips or flaps 28 remain impaled on the match 20 during the following 180° of rotation.

By applying the same analysis to each of the sets of strips or flaps on each of the radial

arms, it will be seen that the same process of opening and closing will be followed by each of the arrays of strips or flaps as the assembly rotates.

Fig. 2 illustrates one particular form of construction comprising a top rail 38 and a bottom rail 40 between which is stretched a wire mesh 42. On the wire mesh are mounted strips of polyethylene 44, 46 and 48, the left-hand edge of each of the strips being affixed to the mesh 42 and the right-hand edge overlying the adjoining edge of the next strip along.

Fig. 3 is a top plan view of the embodiment of Fig. 2 and shows somewhat more clearly the top arm 38 with the separate strips 44, 46 and 48 secured to the wire mesh 42.

Fig. 4 illustrates how a curved vane can be constructed in which a top rod corresponding to 38 in Fig. 3 is designated by reference numeral 50 and the curved surface is formed from a curved mesh 52 on which are mounted a plurality of strips of polyethylene two of which are designated by reference numeral 54 by way of example and each of which is secured along its left-hand edge to the mesh 52, the right-hand edge of each of the strips overlying the stuck-down edge of the next adjoining strip.

Fig. 5 is a perspective view of a completed rotating vane assembly and comprises a generally open rectilinear framework formed from four vertical or near vertical corner struts 56, 58, 60 and 62 which support upper diagonal struts 64 and 66 and lower diagonal struts 68 and 70.

Bearing plates 72 and 74 at the top and bottom of the assembly and carried by the diagonals 64 and 66 on the one hand and 68 and 70 on the other hand provide rotational mountings for a drive shaft or axle 76 on which are mounted four vanes 78, 80, 82 and 84.

Each of the vanes is formed from a wire mesh and has attached thereto a plurality of strips such as are shown in Fig. 2.

At the upper end of the assembly is mounted a housing 84 containing a generator and output lines 86, 88 serve to supply electric current from the generator (not shown) which is driven either directly or through gearing (not shown) from the shaft 76.

The whole assembly is adapted to be driven by the wind or by water current in which latter event the assembly is either partially or completely submerged below the level of the flowing water with the axis of the axle 76 vertical.

CLAIMS

1. A rotational drive for converting linear fluid flow air or liquid into a rotational movement comprises:–

a rotational member mounted for rotation about a vertical axis having at least two radial arms from which movable members depend so as to define a movable baffle which can be acted on by a stream of fluid such as air or water to produce rotational movement,

a second fixed member mounted on one side of the movable members depending from each radial arm which allows fluid flow to pass therethrough when interposed between the fluid flow and the movable members but serving as a stop against which the movable members are forced by the action of the fluid flow when the said movable members are situated in front of the fixed member in relation to the direction of fluid flow,

so that with the direction of fluid flow transverse to the upright vertical axis a greater thrust is transmitted to the radial arm on one side of the axis than the thrust exerted on a diametrically opposite extending radial arm by the fluid flow acting on the other movable members.

2. A rotational drive as claimed in Claim 1 comprising four or more radial arms.

3. A rotational drive as claimed in Claim 1 or 2 in which the radial arms comprise rigid wire mesh nets and the movable members comprise slats or strips of material which are secured to the rigid nets in such a way that the unattached edge of each slat or strip will abut and overly the attached edge of an adjoining strip or slat when the latter are located on the windward side of the net but are capable of being flexed away from the adjoining attached edges when the rigid net is on the windward side.

4. A rotational drive as claimed in Claim 3 in which the strips or slats are attached along edges which are parallel to the central vertical axis of rotation.

5. A rotational drive as claimed in any of the preceding claims in which the rotational member is attached to and drives a vertical shaft.

6. A rotational drive as claimed in Claim 5 in which the rotational member is mounted at the upper end of the vertical shaft and the assembly is supported at the upper end of a tower or the like so as to be influenced by wind.

7. A rotational drive as claimed in Claim 5 in which the rotational member is attached to the lower end of the vertical shaft and the assembly is adapted to be mounted within a river or stream so that the flow of the water induces rotation thereof.

8. A rotational drive as claimed in any of Claims 3 to 7 in which the strips or slats of material are formed from sheet plastics material such as polyethylene.

9. A rotational drive as claimed in any of the preceding claims in which the fixed member and each radial arm define a curved supporting surface, the curvature of which is selected so as to reduce power loss caused for

example by wind spillage.

10. A rotational drive as claimed in any of the preceding claims in which the area of at least the movable baffle depending from each radial arm is variable.

11. A rotational drive as claimed in the preceding claim in which means is provided for automatically varying the area of the movable baffle in response to the speed of rotation of the overall assembly thereby to maintain a a constant speed of rotation from a varying fluid medium speed.

12. A rotational drive as claimed in any of the preceding claims in which the rotatable assembly of arms and movable members is mounted within a generally open framework for overall protection.

13. A rotational drive constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

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ABSTRACT:

Four equally spaced radial arms (12, 14, 16 and 18) support a rigid mesh (20, 22, 24 and 26), attached to each of which are a plurality of hinged or flexible flaps (28) e.g. polyethylene. The mesh is porous to the flow of air or water and consequently the area presented to the flow on one side of the vertical axis of rotation is different from that on the other due to the deflection of the flaps (28) away from the rigid mesh on the one side and the layering function of the flaps on the other side. <IMAGE>